CLAIMS:

1. A multilayer microwave or mm-wave circuit comprising:

a first metallization layer, at least a portion of said first metallization layer adapted for operation at a frequency ranging from 20GHz to 100 GHz;

a second metallization layer, at least a portion of said second metallization layer adapted for operation as a ground plane;

a dielectric substrate layer, said dielectric substrate layer disposed between said first and second metallization layers; and

a plurality of conductive vias extending through said dielectric substrate layer and electrically connecting portions of said first and second metallization layers,

said multilayer microwave or mm-wave circuit being a flexible circuit.

2. The circuit of claim 1, wherein said first and second metallization layers are 0.2 to 3 microns in thickness.

3. The circuit of claim 1, wherein said dielectric substrate layer has a thickness ranging from 50 to 250 microns and a dielectric constant ranging from 1 to 3.5.

4. The circuit of claim 1, further comprising a first polymer layer having a thickness of less than 50 microns, wherein said first metallization layer is provided on said first polymer layer.

5. A multilayer microwave or mm-wave circuit comprising:

a first metallized polymer layer comprising (a) a first polymer layer having a thickness of less than 50 microns and (b) a first metallization layer disposed on said first polymer layer, at least a portion of said first metallization layer being adapted for operation at a frequency ranging from 20GHz to 100 GHz;

a second metallized polymer layer comprising (a) a second polymer layer having a thickness of less than 50 microns and (b) a second metallization layer disposed on said second polymer layer, at least a portion of said second metallization layer being adapted for operation as a ground plane;

a dielectric substrate layer disposed between said first metallized polymer layer and said second metallized polymer layer; and

a plurality of conductive vias extending through said dielectric substrate layer and electrically connecting portions of said first and second metallization layers,

said multilayer microwave or mm-wave circuit being a flexible circuit.

6. The circuit of claim 5 wherein said first and second metallization layers range from 0.2 to 3 microns in thickness.

7. The circuit of claim 5 wherein said first and second polymer layers range from 10 to 25 microns in thickness.

8. The circuit of claim 5 wherein said first and second polymer layers are polyimide layers.

9. The circuit of claim 5, wherein said dielectric substrate layer is a polymethylpentene layer.

10. The circuit of claim 5, further comprising circuit components disposed on said first metallization layer, said circuit components selected from discrete semiconductor components and integrated circuit chips.

11. The circuit of claim 10, wherein said circuit components are attached by a technique selected from chip and wire assembly, chip-on-board assembly and flip-chip assembly.

12. The circuit of claim 5, wherein said first metallized polymer layer and said second metallized polymer layer are adhered to said dielectric substrate layer by an adhesive layer.

13. The circuit of claim 12, wherein said adhesive layer ranges from 10 to 25 microns in thickness.

14. The circuit of claim 5, wherein said vias comprise conductive epoxy-filled through-holes.

15. The circuit of claim 5, wherein said vias comprise metal-plated through-holes.

16. The circuit of claim 15, wherein said through-holes are formed by a process selected from laser ablation and mechanical punching operations.

17. The circuit of claim 5, wherein a plurality of said vias are spaced from one another via by a distance of no more than 0.25 times the operating wavelength or less.

18. The circuit of claim 5, wherein said first and second metallized polymer layers are formed by establishing a fold in a unitary metallized polymer layer.

19. The circuit of claim 5, wherein said first polymer layer, said second polymer layer, and said dielectric substrate layer are able to withstand sustained temperatures of at least 150°C.

20. The circuit of claim 5 wherein said first and second metallization layers are copper layers.

21. The circuit of claim 5, wherein said first and second metallization layers comprise copper sublayers on said first and second polymer layers, nickel sublayers over said copper sublayers, and gold sublayers over said nickel sublayers.

22. The circuit of claim 5, wherein said dielectric substrate layer ranges from 50 to 250 microns in thickness and has a dielectric constant ranging from 1 to 3.5.

23. A microwave or mm-wave sensor comprising:

an antenna section comprising a first metallized polymer film layer;

a circuit section comprising (a) circuit components and (b) a second metallized polymer film layer, which

further comprises metallization adapted for operation at frequencies ranging from 20GHz to 100 GHz;

a signal processing and control section comprising (a) signal processing and control components and (b) a third metallized polymer film layer, which further comprises metallization adapted for said signal processing and control components;

a fourth metallized polymer film layer comprising grounding metallization, portions of said second and fourth metallized polymer film layers being interconnected with one another by a plurality of conductive vias;

a fifth metallized polymer film layer comprising grounding metallization, portions of said third and fifth metallized polymer film layers being interconnected with one another by a plurality of conductive vias; and

a plurality of dielectric layers disposed between said first, second, third, fourth and fifth metallized polymer film layers,

said microwave or mm-wave sensor being a flexible sensor.

24. The sensor of claim 23 wherein said dielectric layers are independently selected from the group consisting of dielectric polymer foam layers and dielectric solid polymer layers.

25. The sensor of claim 23, wherein said first metallized polymer film layer comprises a patch antenna array, wherein said fourth metallized polymer film layer is disposed between said first and second metallized polymer film layers, and wherein said grounding metallization of

said fourth metallized polymer film layer comprises a plurality of antenna feed slots.

26. The sensor of claim 23, wherein said first, second, third, fourth and fifth metallized polymer film layers are formed by establishing folds in a unitary piece of metallized polymer film.

27. The sensor of claim 26, wherein said fifth metallized polymer film layer further comprises metallization lines connecting said second metallized polymer film layer with said third metallized polymer film layer.

28. The sensor of claim 23, further comprising an ungrounded parasitic shield layer, wherein said circuit components and said signal processing and control components are separated from one another by said ungrounded parasitic shield layer.

29. The sensor of claim 23, wherein said metallized polymer film layers and said dielectric layers are bonded together by a plurality of adhesive layers.

30. A microwave or millimeter wave sensor comprising:

an antenna section comprising a first metallized polymer layer, said first metallized polymer layer further comprising (i) a first polymer layer having a thickness of less than 50 microns and (ii) a first metallization layer disposed on said first polymer layer, at least a portion of said first metallization layer comprising a patch antenna array;

a microwave or millimeter wave circuit section over said antenna section, said microwave or millimeter wave circuit section comprising (a) circuit components and (b) a second metallized polymer layer, said second metallized polymer layer further comprising (i) a second polymer layer having a thickness of less than 50 microns and (ii) a second metallization layer disposed on said second polymer layer, at least a portion of said second metallization layer adapted for operation at a frequency ranging from 20GHz to 100 GHz;

a signal processing and control section over said circuit section, said signal processing and control section comprising (a) signal processing and control circuit components and (b) a third metallized polymer layer which further comprises: (i) a third polymer layer having a thickness of less than 50 microns and (ii) a third metallization layer disposed on said third polymer layer adapted for said signal processing and control circuit components;

a first ground-dielectric section between said antenna section and said circuit section, said first ground-dielectric section comprising: (a) a first dielectric layer, (b) a first ground layer over said first dielectric layer and (c) a second dielectric layer over said first ground layer; and

a second ground-dielectric section between said circuit section and said signal processing and control section, said second ground-dielectric section comprising: (a) a third dielectric layer, (b) a second ground layer over said third dielectric layer and (c) a fourth dielectric layer over said second ground layer,

said sensor being a flexible sensor.

31. The sensor of claim 30, wherein said circuit section is oriented such that said circuit components are on a side of said second metallized polymer layer opposite the antenna section, and wherein said signal processing and control section is oriented such that said processing and control components are on a side of said third metallized polymer layer opposite the antenna section.

32. The sensor of claim 31, wherein said first dielectric layer is disposed adjacent said antenna section and comprises a polymer foam layer, wherein said first ground layer is provided with a plurality of antenna feed slots, wherein said second dielectric layer is a solid polymer layer, wherein said third dielectric layer is disposed adjacent said circuit components and comprises a polymer foam layer, and wherein said fourth dielectric layer is a solid polymer layer.

33. The sensor of claim 32, further comprising a fifth dielectric layer adjacent said processing and control components, said fifth dielectric layer comprising a polymer foam layer.

34. The sensor of claim 32,

wherein said first ground layer is provided on a fourth metallized polymer layer which comprises: (i) a fourth polymer layer having a thickness of less than 50 microns and (ii) a fourth metallization layer disposed on said fourth polymer layer, at least a portion of said

fourth metallization layer adapted for operation as a ground layer; and

wherein said second ground layer is provided on a fifth metallized polymer layer which comprises: (i) a fifth polymer layer having a thickness of less than 50 microns and (ii) a fifth metallization layer disposed on said fifth polymer layer, at least a portion of said fifth metallization layer adapted for operation as a ground layer.

35. The sensor of claim 34, wherein said first, second, third, fourth and fifth metallized polymer layers are formed by establishing folds in a unitary metallized polymer layer.

36. The sensor of claim 35, wherein said fifth metallization layer further contains metallization lines connecting said second metallization layer with said third metallization layer.

37. The sensor of claim 32, further comprising

a plurality of conductive vias extending through said second dielectric layer and electrically connecting said first ground layer with second metallization layer and

a plurality of conductive vias extending through said fourth dielectric layer and electrically connecting said second ground layer with said third metallization layer.

38. The sensor of claim 30, wherein said circuit section is oriented such that said circuit components are on a side of said second metallized polymer layer that is

opposite the antenna, and wherein said signal processing and control section is oriented such that said processing and control components are on a side of said third metallized polymer layer that is the same as that of the antenna section.

39. The sensor of claim 38, wherein said first dielectric layer is disposed adjacent said antenna section and comprises a polymer foam layer, wherein said first ground layer is provided with a plurality of antenna feed slots, wherein said second dielectric layer is a solid polymer layer, wherein said third dielectric layer is disposed adjacent said circuit components and comprises a polymer foam layer, wherein said second ground layer is a parasitic shield layer, and wherein said fourth dielectric layer is a polymer foam layer.

40. The sensor of claim 39, further comprising a fifth dielectric layer adjacent said third polymer layer and a third ground layer adjacent said fifth dielectric layer,

41. The sensor of claim 39,

wherein said first ground layer is provided on a fourth metallized polymer layer which comprises: (i) a fourth polymer layer having a thickness of less than 50 microns and (ii) a fourth metallization layer disposed on said fourth polymer layer, at least a portion of said fourth metallization layer adapted for operation as a ground layer;

wherein said second ground layer is provided on a fifth metallized polymer layer which comprises: (i) a

fifth polymer layer having a thickness of less than 50 microns and (ii) a fifth metallization layer disposed on said fifth polymer layer, at least a portion of said fifth metallization layer adapted for operation as a parasitic shield layer and

wherein said third ground layer is provided on a sixth metallized polymer layer which comprises: (i) a sixth polymer layer having a thickness of less than 50 microns and (ii) a sixth metallization layer disposed on said sixth polymer layer, at least a portion of said sixth metallization layer adapted for operation as a ground layer.

42. The sensor of claim 40, wherein said first, second, third, fourth, fifth and sixth metallized polymer layers are formed by establishing folds in a unitary metallized polymer layer.

43. The sensor of claim 40, further comprising:

a plurality of conductive vias extending through said second dielectric layer and electrically connecting said first ground layer with second metallization layer and

a plurality of conductive vias extending through said fifth dielectric layer and electrically connecting said third ground layer with said third metallization layer.